

Part II Zoology

2020-21



UNIVERSITY OF
CAMBRIDGE

Why choose Part II Zoology or Part II BBS Zoology?

If you have enjoyed subjects that include **animal behaviour**, **conservation science**, **ecology** and **evolution** during your time at Cambridge, then you might well have already decided that Zoology is the Part II subject for you. But we also provide outstanding teaching in **cell and developmental biology** and each year we attract students that specialise in these subjects alone, and go on to study for a higher degree in these research areas. Our uniquely flexible course is also ideal for NST students that enjoy both cellular and organismal biology, because you can take a combination of our diverse modules.

If you are taking the MVST, then we can enhance your training in several ways: by showing you how healthy bodies develop and function; by teaching you more about the processes that trigger cancer; by explaining how evolutionary principles underpin the design of a new flu vaccine, and account for constraints on immune function; by revealing the evolutionary history of humans and their domesticated animals; and by highlighting how rapid man-made changes in our world have substantial implications for human and animal the health of living things and their environments.

We will provide a nurturing and stimulating environment for your Part II studies. Part II students are valued members of the Department, have their own dedicated computer facility, are invited to research seminars, and can join members of staff in the tea room and at our Happy Hour. We want you to excel in your third year at Cambridge, so we provide additional training in understanding the scientific process, essay-writing, reading a research paper, preparing a research project or dissertation, and giving a research talk. We also prepare you for the future with a careers session and advice on applying for postgraduate study.

For further information visit: www.zoo.cam.ac.uk. If you are unable to find the answer to your query please contact Part II Zoology and BBS Organiser, Professor Andrew Balmford ([3]31770, apb12@cam.ac.uk) or the Zoology Teaching Office (teaching@zoo.cam.ac.uk).

Dr Howard Baylis
Head of Department

Professor Andrew Balmford
Part II Organiser

Cover image: A group of sailfish hunting a school of sardines
Photo courtesy of Rodrigo Friscione Wyssmann

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*(Please note that * starred sections above are **not** relevant to BBS Zoology students, but all others are)*

OVERVIEW OF THE PART II ZOOLOGY COURSE

An overview of the BBS Zoology course can be found on page 25.

The course is made up of:

Lecture modules in the Michaelmas and Lent terms. Students take two modules each term, but are free to attend lectures in any modules.

Project/demonstration practical work. Students must do either one **two-term** project, or two **one-term** projects. Students attending the Tropical Field Course will use their research to form the basis of a one-term research project. At the beginning of Easter term, students give a compulsory **oral presentation** on one of their projects.

Research Project Proposal. Students will write a short research proposal on a topic from a module they are taking in Michaelmas or Lent term. This exercise will help students to think logically and practically about a research topic of their choice, and gives students the opportunity to prepare for future research applications.

Statistics course in Michaelmas term. This optional course is designed to familiarise students with quantitative methods and computing and is not examined.

Long vacation field course

This year our Tropical Field Course is based at the Smithsonian Tropical Research Institute in Panama and provides an excellent opportunity for students to learn about tropical rainforest ecology, evolution and conservation. Students attending the course will use this research to form the basis of a Part II project.

Special seminars

In addition to these formal parts of the course, there are approximately 10 special seminars on a range of topics such as careers advice and how to give a research presentation.

AIMS, OBJECTIVES AND LEARNING OUTCOMES OF PART II ZOOLOGY

Aims

- To provide a broad multidisciplinary course in Zoology.
- To train students in a wide range of science-based skills that provide the learning base for future careers in disciplines such as health sciences, agriculture, environmental management, the emerging biotechnologies, publishing, teaching, research and management.

Objectives

- To offer a modular course of lectures, associated seminars and research projects, supported by supervisions where appropriate.
- To promote training in practical and conceptual skills in sub-disciplines ranging from molecular cell biology, through physiology and neurobiology, to the study of populations in both an ecological and evolutionary framework.
- To provide constructive feedback on students' work. During the course individual students will receive feedback on their project/s and written work for supervisions.
- To provide an optional Zoology-based course in statistics in the Michaelmas Term enabling students to apply quantitative methods to complex biological problems.
- To provide professional training in effective verbal and written communication skills.
- To generate new research ideas, techniques and analytical approaches that could be used to make future discoveries.

Outcomes

At the end of the course students should be able to:

- Think critically in terms of their learning and research.
- Critically evaluate the published literature.
- Assess and implement the practical techniques necessary to solve a particular biological problem.
- Analyse and interpret data collected during a research project.
- Communicate with expert and non-expert audiences through seminar presentations, project reports and essays.
- To assess the current state of a research field and design methods to test key questions.

ASSESSMENT

Coursework comprises the research project proposal and either two project write-ups, one for each one-term project, or one longer write-up of a two-term project. At the end of the academic year are four three-hour written examination papers, one for each module taken. On each of these four papers, candidates answer three questions.

PROJECT WORK

You may do two one-term projects, each amounting to about 80 hours of practical work and analysis, or one two-term project of about 160 hours in total. Student projects often lead to publications.

Module ZM1 carries with it demonstration practicals following the lectures.

DEPARTMENTAL RESOURCES FOR PART II STUDENTS

During your Part II year, you will be treated as a full member of the Department, which is diverse in its research interests. There is a tradition of easy and informal access to members of the teaching staff and others, with whom students share the **Tea room** and other facilities and activities. The friendliness of the Department is often one of the first things a student will mention about the course.

Part II students have full use of the excellent and comprehensive facilities provided by the **Balfour Library**, including workstations. There is also a dedicated **Common Room** with full facilities.

You will also be welcome to attend **Happy Hour** in the Tea room on Friday afternoons. **Parties** for Part II students are held at the start of Michaelmas Term and after the exams.

EXPLORING YOUR INTERESTS WITHIN ZOOLOGY

We know from experience that your interests may not always fall tidily into the standard areas of biology such as "ecology", "evolution", "behaviour", and/or "cell biology". Many students wish to get experience of different aspects of animal biology, and Part II Zoology is organised with this in mind. **The only requirement is that you select two modules in each of the two teaching terms.** Often the interface between two conventional areas is a growing point in the subject, which is why we encourage this freedom of choice.

We encourage you to follow your interests as far as possible, even if you have not previously studied a particular area. All modules are taught in a way which is designed to maximise their accessibility to students taking the course. If you have any concerns about your ability to take a particular module you should contact the module organiser who will be very willing to advise you.

You need not decide on your modules until you have sampled what is available at the beginning of each term. This booklet outlines the contents of the modules in order to indicate what is available. Although the modules can be combined according to individual choice, the following are examples of some of the more obvious combinations (modules lettered and numbered for convenience; M = Michaelmas Term module, L = Lent Term module).

Students are required to attend all lectures on their chosen modules, therefore a small number of module combinations will not be possible due to schedule clashes.

- **An evolutionary biologist** might select two of ZM1, ZM2, ZM4 and ZM5, followed by ZL3 and ZL5.
- **An ecologist or conservation biologist** might select two of ZM2 and ZM5, followed by two out of ZL2, ZL3, ZL4 and PLM3 (see p. 24 for more details).
- **A cell or developmental biologist** might choose two from ZM6, ZM7 and ZM8 and two from ZL5, ZL6, ZL7 and Bioinformatics (see p. 23 for more details).

- Someone interested in **neurobiology and behaviour** might select ZM4 and ZM5, followed by ZL3 and ZL5.

These are simply examples to show ways in which the modules can be combined to meet individual interests. Members of the staff will be very happy to discuss other combinations, and to give you advice.

LONG VACATION FIELD COURSE

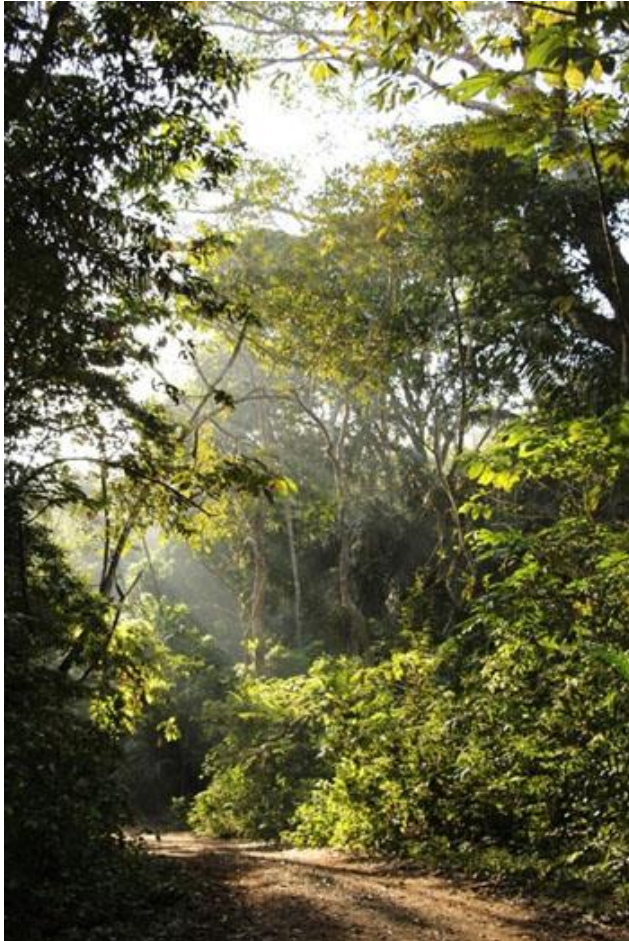
30 August – 13 September 2020

Organiser: Professor Chris Jiggins, c.jiggins@zoo.cam.ac.uk



During the summer of 2020 the Department will be returning to Panama to run its second Part II field course based in the Smithsonian Tropical Research Institute. We will benefit from a long history of tropical research that has been carried out in Panama which includes geological studies of the rise of the isthmus and the Great American Biotic Exchange. In addition, many iconic ecological and evolutionary studies have been carried out here. These include sexual selection and predation in tungara frogs and their bat predators; mutualism between leaf-cutting ants and their fungus gardens; the debate over the neutral theory of biodiversity, informed by data from the 50 ha plot; *Heliconius* butterflies and mimicry; fig wasps and their fig hosts, including tests of local mate competition theory and the discovery of cryptic wasp species diversity.

Conservation issues include the role of the Canal in protecting the watershed forest; encroachment on national parks by farmland and hunting; freshwater invasive species in the canal and Chagres river; carbon balance of tropical forests and likely responses to increased atmospheric carbon.



Module ZM1: Vertebrate Evolution

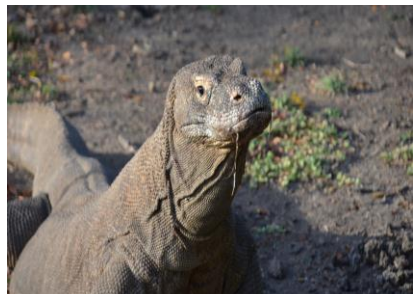
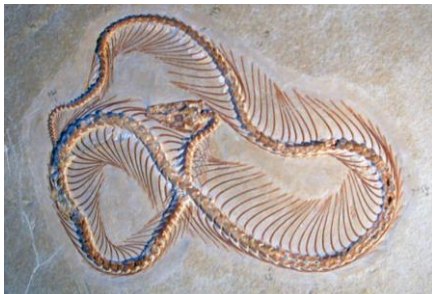
Also available as a BBS Minor subject

Module organiser: Dr Jason Head, jjh71@cam.ac.uk

This course introduces the evolution of vertebrates, integrating information from the fossil record, development, and ecology to examine major events in vertebrate history. These include the origin of vertebrates, hypotheses surrounding the origins and homologies of jaws and limbs, the evolution of vertebrates onto land, the origins and adaptive radiations in diverse groups such as ray-finned fishes, lizards, and birds, the mechanics of locomotion and feeding among dinosaurs, the evolution of specialized anatomies such as the turtle shell and the snake body form, and the kill mechanisms behind mass extinction events. The nature of the fossil record, including the processes that form the record from death to discovery, are also discussed, as is the role of the fossil record in helping to understand the future implications of human-induced environmental change.

Students will be exposed to a range of analytical techniques and philosophical approaches for inferring vertebrate history, including phylogeny reconstruction methods, comparative anatomical observation, phylogenetic taxonomy, and conservation palaeobiology methods.

Important components of the course are demonstration practical sessions which are held in the exhibit halls and demonstration rooms in the University Museum of Zoology. These sessions provide students with direct access to the fossil and modern anatomies that underpin the major hypotheses discussed in lectures. An additional practical session is held in the exhibits of the Sedgwick Museum.



Skeleton of the fossil snake *Euopodophis descouensei* from 95 million year old ocean deposits in Lebanon (Rieppel and Head, 2004), *Varanus komodensis* from Rinca Island, Komodo National Park, Indonesia

Module ZM2: Conservation Science

(Inter-departmental course with Plant Sciences)

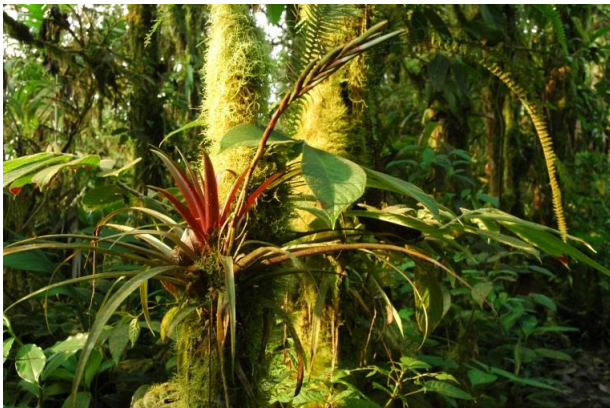
Also available as a BBS Minor subject

Module organiser: Dr David Aldridge, da113@cam.ac.uk

This interdepartmental course, taught by the Departments of Zoology and Plant Sciences, aims to provide an understanding of why wild nature is currently in decline, why this matters, and how biology coupled with other disciplines can be harnessed to identify potential solutions.

The course begins by explaining the distribution and importance of biodiversity, and the evidence that it is currently being lost. It then examines in detail the immediate threats to wild populations and their habitats, and the underlying drivers of those threats. The final section of lectures explores potential solutions, combining socio-economic as well as biological insights to take a constructively critical look at approaches ranging from sustainable harvesting and ecosystem restoration to agri-environment schemes and the marketing of ecosystem services.

Core lectures are supplemented by case studies given by outside experts on policy and conservation practice. There is also a field trip, a careers session, a class debate and a guided tour round various conservation organisations based in the David Attenborough Building.



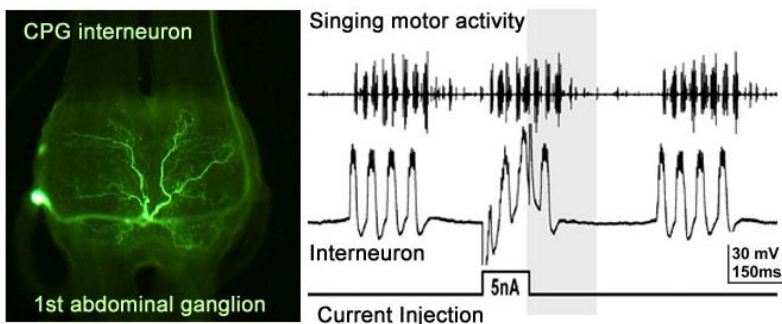
Module ZM4: Neuroethology: The Neural Basis of Adaptive Behaviour

Also available as a BBS Minor subject

Module organiser: Dr Berthold Hedwig, bh202@cam.ac.uk

These lectures place a strong emphasis on understanding the neural mechanisms underlying behaviour. Within this module we explore how nervous systems are organised, how animals gather and process information about the environment, and how they generate the motor activity underlying their behaviour.

The first lectures will give an introduction into the organisation and adaptations of brains and will show how an animal's neuronal capabilities are linked to energy, ecology and lifestyle. We then consider neural circuits and the control of motor patterns. We demonstrate how auditory and visual processing is adapted to the lifestyle in insects and other species. Larval and adult *Drosophila* will be discussed with an emphasis on genetic techniques to study their nervous system and behaviour. Finally, we will demonstrate the basis of plasticity and learning in neural networks and behaviour at a circuit and cellular level.



A central pattern generator interneuron in the cricket abdominal ganglion controls the insect's singing behaviour

Module ZM5: Evolution and Behaviour: Genes and Individuals

Module organiser: Dr Nick Mundy, nim21@cam.ac.uk

The classical way to study animal behaviour separates questions concerned with function (what is the adaptive value of the behaviour? what is its evolutionary history?) from those focused on causation (how is the behaviour controlled? how does it develop during a lifetime?). The aim of this course to show how recent research is sweeping aside these traditional distinctions in two different ways, yielding new insights into the way that evolution works. Specifically:

- 1) Animal behaviour, and the mechanisms by which it develops, can contribute to evolutionary change: by changing ecological conditions; by imposing selection on other parts of the phenotype and other individuals; by influencing patterns of inherited variation; and by facilitating reproductive isolation.
- 2) At the same time, the mechanisms controlling behaviour and its development are themselves subject to natural selection and are adaptations for the ecological conditions in which an animal lives. This means that we can predict the particular mechanisms involved in behavioural development, as well as an animal's immune function and its specific cognitive and sensory capacity, from aspects of its ecology.

The first half of the course focuses on the genetic foundations of behaviour and the consequences for evolutionary processes such as adaptation and speciation. In the second half of the course, the emphasis is on the adaptive value of cognitive, sensory and immune function and how they contribute to individual variation.



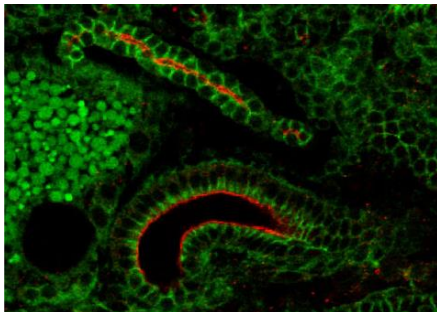
Module ZM6: Cell Assembly and Interactions

(Inter-departmental course with PDN)

Module organiser: Dr Tim Weil, tw419@cam.ac.uk

Cells are highly organised and dynamic structures. In this module we will explore how the architecture of the cell is constructed and how cells interact with each other and their environment in order to fulfil their myriad roles in animals. Our current knowledge of these vital topics will be presented in depth, with a focus on the molecular mechanisms that regulate cell behaviour. We will examine how cells use basic cell biological mechanisms in their complex activities within animals, including cellular behaviour during development and how cellular activities provide key physiological functions in the adult.

We begin with an examination of how cells become polarised and adhere together to form higher order multicellular assemblies. We will then explore how nuclear organisation and architecture of the genome reflects and regulates gene function. This is followed by a discussion of how membrane compartments are constructed, and the dynamics of transfer between them. Next is a section of theories to explain how cells were first created and then evolved into the great diversity of cell morphologies and function observed today. We will then discuss the role of the cytoskeleton in cell shape, division, organisation and movement. Specifically, we will cover cell motility, the relationship between centrosomes and microtubules, how cells sense and respond to the mechanical properties of their surroundings and morphogenesis.



This is an interdepartmental course (PDN and Zoology). In addition to lectures there are several interactive sessions (such as journal clubs) in which there will be discussions of key papers, experimental techniques and major concepts in the field.

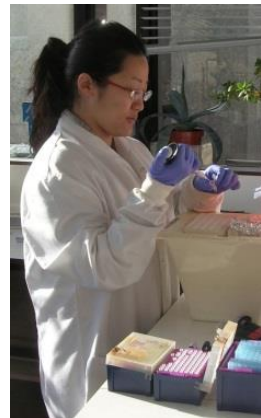
Module ZM7: From Genome to Proteome

(Inter-departmental course with Biochemistry)

Module organiser: Dr Torsten Krude, tk218@cam.ac.uk

This course aims to introduce and discuss the regulation of gene expression using a wide range of examples and different model organisms, and to introduce the range of methodology that is used in such studies. This course aims to take you from the level of familiarity with textbooks and reviews up to the level of reading, understanding and critically evaluating original research papers.

Control of gene expression is a topic that addresses the flow of information from the genome to the proteome. It includes the steps of gene transcription (i.e. mRNA synthesis), splicing, mRNA localization within the cell, and protein synthesis (i.e. mRNA translation). Understanding gene expression is important for understanding the fundamental functions of cells, how cells proliferate, how they respond to environmental stimuli, how they change their function during differentiation and how new complex patterns and structures emerge during development. An understanding of the molecular mechanisms that regulate gene expression is therefore an essential topic of contemporary cell and developmental biology. This module introduces and discusses the factors which catalyse and regulate transcription, RNA localization and translation. It also addresses newly emerging concepts, which provide additional levels of regulation and complexity. For instance, genome projects have focussed more and more attention on patterns of gene expression in different cells, different tissues and different organisms. The tool of RNA interference has been developed to knock-out the expression of any specific gene in living cells to study the function of that particular gene *in vivo*. Small non-coding RNAs have been identified as regulators for fine-tuning gene expression in many systems. Finally, the coordination of gene expression between the cell nucleus and organelles containing their own DNA will be discussed. This module is fully interdepartmental and the lectures are also taken by students reading Part II Biochemistry. The lectures are given in the Department of Biochemistry by members of the Departments of Zoology, Biochemistry and the Gurdon Institute.



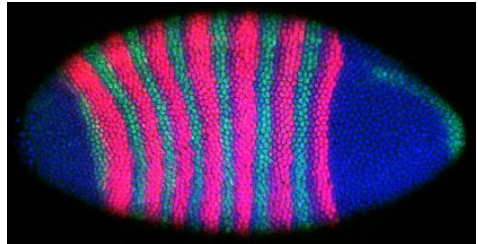
Module ZM8: Development: Patterning the Embryo

(Inter-departmental course with PDN)

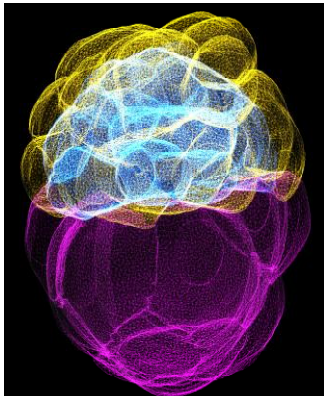
Module organiser: Dr Howard Baylis, hab28@cam.ac.uk

How does a single cell, the fertilized egg, develop into an animal? This is one of the most fascinating and important questions in biology. In this course we address that question. The course is the first of two complementary modules (with ZL6), which can also be taken on their own.

Our current knowledge of the underlying molecular mechanisms that create cell diversity and pattern in the early embryo will be examined in depth. We will discuss how the experimental advantages of different organisms have aided the discovery of the principles of



development, and the insights provided by comparing the developmental strategies of vertebrates and invertebrates. We will address key aspects of early development, including how development is regulated, how the patterning of spatial information is established and how morphogenetic mechanisms shape the embryo.



At each stage we will discuss the cellular mechanisms required and the molecular networks that drive them. By comparing the development of different animals we aim to come to an understanding of conserved strategies of animal development.

We aim to provide a course that is accessible to anyone doing Part II Zoology whatever your previous background.

Module ZL2: Responses to Global Change

(Inter-departmental course with Plant Sciences)

Module organisers: Dr David Aldridge, da113@cam.ac.uk (Zoology)

Professor Howard Griffiths, hg230@cam.ac.uk (Plant Sciences)

Global temperature is on the increase, extreme climatic events are increasing, and the sustainability of agricultural land use and vegetation cover is being challenged; pest and pathogen impacts are exacerbated in a warming world and their spread accelerated by human interactions. The scientific challenges underpinning these dramatic changes, and our collective response, will shape your future, and that of a growing global population. The module provides a generic background to climate change adaptation and mitigation, before considering a succession of timely issues in depth.

A range of experts with different perspectives deliver the course: Global limits to growth: planetary boundary layers and their impacts in key areas of water resources, ecosystem fertilisation and greenhouse gas emissions (Andrew Tanentzap); Impacts of seasonality and phenological mismatch on bird population dynamics in a changing world and development of appropriate conservation practices (James Pearce-Higgins, British Trust for Ornithology); Forests on the edge: combined impacts drought, fire and pestilence threaten carbon sequestration whilst sustainable water use is required for crop growth around the world (Howard Griffiths); Use of modelling to scale physiological limitations on plant growth from leaf, via canopy, to ecosystem (Wanne Kromdijk); Modelling epidemiology and plant pathogen distribution in a changing world (Nik Cunniffe); The “Madingley Model” of ecosystems and biodiversity: development of policy from projections of biodiversity change under different scenarios of human development (Mike Harfoot, UNEP-WCMC); Evidence-based analyses of insect declines and invasive species: how should society respond to the need for sustainability in the face of climate change? (Lynn Dicks)



Module ZL3: Evolution and Behaviour: Populations and Societies

Module organiser: Professor Rufus Johnstone, raj1003@cam.ac.uk

This module aims to provide a functional interpretation of variation in animal social behaviour and inter-species interactions. The underlying theme is that individuals will behave in ways that promote their genetic contribution to future generations. The way in which they do so is constrained by their ecology and by social interactions with members of their own and other species.

The course aims to provide you with an understanding of:

- 1) the framework of evolutionary theory that is used to explain variation in animal social behaviour;
- 2) the way in which ecology and social competition constrain and control evolutionary options;
- 3) the empirical evidence that supports functional interpretations of social behaviour and life history (including observation, comparative and experimental studies).

Lecture blocks deal with social evolution, communication, family life, individuals and groups, coevolution (from mutualism to parasitism) and major transitions in social evolution.



Module ZL4 - Applied Ecology

Module Organiser: Dr Edgar Turner, ect23@cam.ac.uk

All too often, managers of natural resources make ill-informed decisions that can have devastating consequences upon ecosystems and the human populations who depend upon them. This module is about how a sound understanding of ecological processes can greatly improve our ability to manage ecosystems in a desirable way.

The course considers a diverse range of applied applications of ecological knowledge, from understanding disease epidemics, to predicting the future impacts of climate change. It also considers the role of applied ecology in a diverse range of environments, from the world's most remote island groups and Polar regions, to familiar agricultural landscapes.

Different sections of the course include ecological approaches for the control of influenza, the control of invasive species on islands, the ecology of Antarctic ecosystems in the face of environmental change, applying lessons from palaeobiology to modern changes in species, and ecology in agricultural environments. As well as lectures, the course also includes sessions with applied ecologists from the David Attenborough Building and seminars that enable students to explore aspects of applied ecology in more detail.

Students taking this course will learn how a well-trained and enthusiastic ecologist can apply their scientific knowledge to make a real change to the world around them.



Module ZL5: Evolutionary genetics and adaptation

Inter-departmental course with genetics (M4)

Also available as a BBS Minor subject

Module organiser: Professor Chris Jiggins, c.jiggins@zoo.cam.ac.uk

Modern evolutionary theory has its roots in the union of Mendelian genetics with Darwin's theory of evolution, two of the great unifying themes of biology. This course will consider the process of evolution from a genetic perspective, exploring the central topics of natural selection, adaptation and genetic drift, and combining a variety of empirical and theoretical approaches. Alongside this, the course will explore how genomes themselves are shaped by selection, drift and their evolutionary history. This course lies at the interface of whole organism biology and molecular genetics.

These lectures will begin by introducing the basic principles of population genetics such as selection and drift. It will then illustrate how adaptive thinking can be applied to features of genomes, and explore the different ways in which a geneticist might test adaptive hypotheses. **How do genomes evolve?** A large proportion of many genomes consists of repetitive DNA, which replicates itself at the expense of the organism – a form of genomic parasitism. Other sources of conflict occur between the sexes, and between parents and offspring. We will look at the genetic basis of sex determination and how this can lead to conflict between chromosomes. **How are species and populations related?** We look at how we can reconstruct species relationships from DNA sequences, and how this can inform our understanding of traits such as human language. **What is the genetic basis of adaptation?** Do we expect evolutionary change to involve few or many genes? What kinds of genes control recent evolutionary changes? Butterfly wing patterns and many other examples are used to illustrate these questions.



Module ZL6: Development: Cell Differentiation and Organogenesis

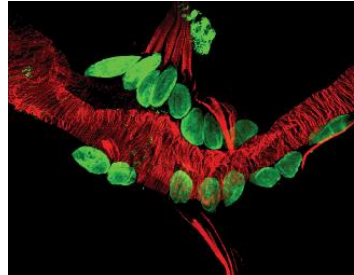
(Inter-departmental course with PDN)

Module organiser: Dr Tim Weil, tw419@cam.ac.uk

This course is the second of two complementary Developmental Biology modules (with ZM8) that can also be taken on their own. This module examines a second phase of embryonic development, following the initial steps of defining axes, major cell layers, and broad pattern domains that are covered in ZM8.

This interdepartmental course (with PDN) will consist of three lectures per week, and seven interactive sessions (such as journal clubs) in which we will aim to discuss key references and the concepts presented in the lectures.

A series of topics will be presented, each using particular tissues or organs to highlight individual developmental mechanisms. Thus, the generation of airways and vasculature addresses principles of tubulogenesis; vertebral column and lung illustrate mechanisms of cell allocation and morphogenesis; limb development illustrates how patterning mechanisms are coordinated with cell proliferation; the progressive determination of cell lineages and establishment of stem cells shows how organs are derived; and the development of pharyngeal arches, neural crest cells and craniofacial organizing centres demonstrates how epithelial-mesenchymal interactions instruct cell differentiation and patterning in the head.



A mixture of examples from simpler invertebrate models and vertebrates will show how developmental mechanisms have diversified with increasing cell number.

Module ZL7: Cell Cycle, Signalling and Cancer

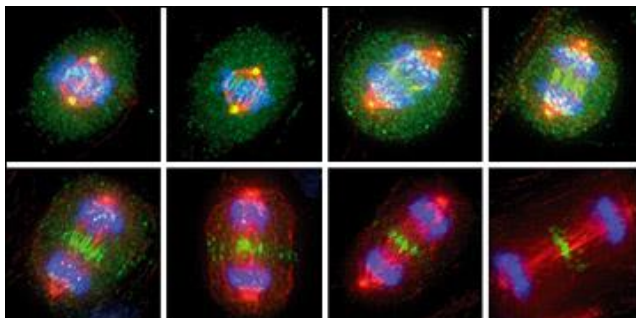
(Inter-departmental course with Biochemistry)

Module organiser: Dr Torsten Krude, tk218@cam.ac.uk

Precise control of cell proliferation is crucial to the normal development and homeostasis of multi-cellular organisms. Failure to accurately regulate these processes can lead to cancer. This course aims to provide a broad molecular understanding of the processes underlying cell proliferation in normal development and disease. It aims to explore experimental systems to study tumour biology, and to critically discuss therapeutic strategies against cancer.

This course will first concentrate on the molecular mechanisms underlying controlled cell proliferation, including cell cycle control, replication of DNA, repair of DNA damage and programmed cell death. It will then apply this fundamental understanding of cell proliferation and homeostasis to explore tumours as aberrantly proliferating tissues, including the interplay between oncogenes and tumour suppressors, and the specific topography of tumour microenvironments. Finally, this course will consider therapeutic anti-cancer strategies, including tumour virus vaccination, small molecule drugs and antibody-based therapies. It further aims to illustrate the experimental approaches used, to highlight important questions that remain to be answered, and to encourage critical evaluation of the scientific literature.

This module is fully interdepartmental and the lectures are also taken by students reading Part II Biochemistry. The lectures are given in the Department of Biochemistry by members of the Departments of Zoology, Biochemistry and the Gurdon Institute, as well as by several external experts.



Deconvolved images of HeLa cells progressing through mitosis stained for Polo-like kinase 1 (green), tubulin (red) and DNA (blue)

Modules organised by other departments:

Module PLM3: Evolution and Ecosystem Dynamics (Plant Sciences)

(Michaelmas term: 24 lectures)

Module Organiser: Dr Andrew Tanentzap (Plant Sciences),
ajt65@cam.ac.uk

For the first half of the module, we consider the origins and diversification of the land plant flora. As plants colonised the land, the phylogenetic progression is reflected in key physiological advances which provide a palaeohistorical framework. A workshop on practical aspects of measuring phylogeny then leads in to a more detailed comparison of factors leading to the evolution of three key groups, namely ferns, conifers and angiosperms. Aspects of generating ecological diversity are then developed through priority effects, with consideration then given to specific examples of factors regulating biodiversity in forest ecosystems, through co-existence, regeneration and dispersal. We also consider differences in diversity between primary and secondary tropical forests.

Module Bioinformatics (Genetics - also available as a BBS minor subject)

(Lent term: 14 lectures, 9 practical sessions)

Module Organiser: Bioinformatics Training Facility (Genetics),
grad.bioinfo@lifesci.cam.ac.uk

This module will provide an introduction to fundamental concepts underlying bioinformatics research and enables students to practice the analysis of high-throughput data using a range of tools and methods.

It will consist of 14 lectures and 9 computer-based practical sessions. During the practical sessions, students will use the Unix command-line environment and the R project for statistical computing.

Aims:

- Learn bioinformatics approaches used in cutting-edge genomics and other biomedical sciences;
- Process, analyze and interpret HTS data;
- Learn basic computational skills crucial for modern research

CELL AND DEVELOPMENTAL BIOLOGY IN PART II ZOOLOGY

The Department of Zoology offers the choice of eight exciting Part II Cell and Developmental biology modules. Students can focus purely on these topics if they wish. However one of the advantages of studying these research areas in the Department of Zoology is that we offer a very wide range of other options with which cell, molecular and developmental biology can be combined. Indeed research and teaching in Zoology covers the range of animal biology from cells, molecules and embryos to nervous systems, ecology and evolution.

You should study two modules a term. The cell biology modules offered are:

Michaelmas Term

- ZM4 Neuroethology: The Neural Basis of Adaptive Behaviour
- ZM6 Cell Assembly and Interactions
- ZM7 From Genome to Proteome
- ZM8 Development: Patterning the Embryo

Lent Term

- ZL5 Evolutionary Genetics and Adaptation
- ZL6 Development: Cell Differentiation and Organogenesis
- ZL7 Cell Cycle, Signalling and Cancer
- Bioinformatics

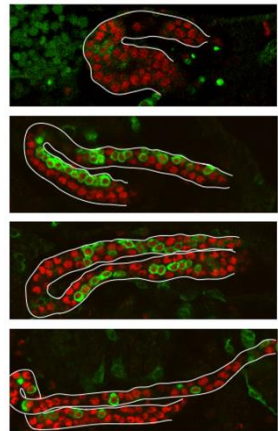


Photo by Kyra Campbell

ECOLOGY IN PART II ZOOLOGY

Many NST II Zoology students take what is in effect an ecology course at Part II level. There are six modules which may appeal to students interested in this route, and many students select four of these. However, it is also possible to combine a selection of these with some of the other modules on offer.

You should study two modules a term. The ecology modules offered are:

Michaelmas Term

- ZM2 Conservation Science
- ZM5 Evolution and Behaviour: Genes and Individuals Behaviour

Lent Term

- ZL2 Responses to Global Change
- ZL3 Evolution and Behaviour: Populations and Societies
- ZL4 Applied Ecology



Photo by Nanna Evers

One Michaelmas Term module available to Zoology students is organised by the Plant Sciences Department:

- PLM3: Evolution and Ecosystem Dynamics

PART II Biological & Biomedical Sciences (Zoology)

Course Structure

The BBS Zoology course is composed of a combination of four of the single modules listed on our website. They will be examined at the same time as Part II Zoology. Students also take another module for examination from the available minor subjects and submit a Dissertation supervised by Zoology or another Department.

BBS Zoology students are encouraged to attend the course on Statistics for Biologists provided by the Department of Zoology at the start of the Michaelmas Term.

BBS Zoology (major) students can take any two of the Michaelmas term modules and any two of the Lent term modules, provided the timetables do not clash with their minor subject. Timetables for the Zoology modules are available at:

<https://www.zoo.cam.ac.uk/study/NST-II-Zoology/modules>

and the minor subject timetables can be found at:
www.biology.cam.ac.uk/undergrads/nst/bbs/Timetable

Note that the vertebrate module ZM1 involves some practical work which is taken by Part II students after the lectures, which can potentially clash with lectures in your minor subject. Please consult with module organisers if these demonstrations are required at other times.

The following Zoology modules are available as a BBS minor subject:

- ZM1 Vertebrate Evolution
- ZM2 Conservation Science
- ZM4 Neuroethology: the neural basis of adaptive behaviour
- ZL5 Evolutionary Genetics and Adaptation

Therefore it is possible to take Biological and Biomedical Sciences entirely within the Department of Zoology (timetable permitting).

Aims of Part II BBS Zoology

Through guided reading, lectures, essays, seminars, and bibliographic reviews (dissertations) students will be educated and trained in a wide range of scientific skills which provide the learning base for future careers in disciplines such as behaviour, developmental biology, ecology, agriculture, environmental management, publishing, teaching and management.

Learning Outcomes for students

At the end of the lecture courses students should be able to:

- Think critically in terms of their learning and research.
- Critically evaluate the published literature.
- Be aware of the techniques needed to analyse and quantify data collected during a research project.
- Communicate with expert and non-expert audiences through seminar presentations, bibliographic project reports and essays.

ASSESSMENT

The Part II BBS Zoology course is assessed as follows:

Four three-hour examination papers as set for Zoology Part II. Candidates are asked to answer three questions on each paper. Marks will be combined with those from the Dissertation and the fifth (minor subject) exam paper, to provide the six examination elements necessary to meet the requirements of the BBS Part II degree

For more information on the BBS course please refer to their website:

<https://www.biology.cam.ac.uk/undergrads/nst/bbs>

Back image: *Drosophila melanogaster* cuticle and muscle labelled for cytoskeletal proteins. Image acquired in the Zoology Imaging Facility on an Olympus FV3000 Confocal Laser Scanning Microscope. Weil Lab.

